REMARKS

Applicant respectfully requests consideration of the subject application. This Response is submitted in response to the Office Action mailed December 20, 2007. Claims 8, 9, 12-16 and 20, 23-30 are now pending. New claims 23-30 are added to more clearly define the invention. In this Amendment, claims 8 and 12 are amended to also more clearly define the invention. This amendment to the claims is made solely for the purpose of expediting the issuance of the present application. No new matter has been added.

35 U.S.C.§ 103 Rejections

1. The Examiner has rejected claims 8-9, 12, 14-16 and 20 under 35 U.S.C.§ 103(a) as being unpatentable over Dasgupta et al (US 2003/0152835 A1) in view of Gurin (US 2003/0151030A1).

Applicant previously amended the claims to clarify that the binder recited in Claim 8 is <u>selected from the group consisting</u> of sulfur having an average particle size of 1μm or less, metal nanoparticles having an average particle size of 1μm or less and both of them. The amendment is supported by the description at page 12, line 25 to page 13, line 9 and page 19, line 6 to page 20, line 2 of the present specification.

The Examiner asserts that the present invention as claimed does not exclude using a binder comprised of materials such as organic polymers, in

conjunction with sulfur or metal nanoparticles.

Applicant respectfully draws the attention of the Examiner to MPEP 2111.03 which states:

"The transition phrase "consisting of" *excludes any element, step, or ingredient not specified in the claim*. *In re Gray, 53 F.2d 520, 11 USPQ 255 (CCPA 1931); Ex parte Davis, 8 USPQ 448, 450 (Bd. App. 1948) ("consisting of" defined as "closing the claim to the inclusion of materials other than those recited except for impurities ordinarily associated therewith")."* (Emphasis added).

Furthermore, MPEP 2111.03 states:

"In contrast, the court noted the phrase "group c consisting of" is a closed term, which is often used in claim drafting to signal a "Markush group" that is by its nature closed." (Emphasis added).

Therefore, both claims 8 and 23 contain a Markush group claim which is by definition closed and excludes any element, step, or ingredient not specified in the claim. Therefore, the Markush group explicitly excludes a binder comprised of materials such as organic polymers in conjunction with sulfur or metal nanoparticles. By definition, the binder consists of only the sulfur or metal nanoparticles and therefore should be found allowable.

Because applicant has used the words "group consisting of", the binder materials are closed and therefore cannot contain other materials in contrast to the Examiner's assertion.

In addition, the Examiner asserts that the use of sulfur or metal nanoparticles having the effect of minimizing the internal resistance of the electrode is not claimed.

So, through this opportunity to make an amendment, the present applicant inserts the recitation "wherein the binder has the effect of minimizing the internal resistance of the electrode" into claim 8 so as to indicate that the present invention produces an effect of minimizing the internal resistance by the use of a binder recited in claim 8. Further, the amendment is made to clarify that the technical ideas of the present invention lie in that the sulfur or metal nanoparticles are used as a binder to solve a technical problem that the internal resistance of the electrode is increased due to the organic binders when organic polymers are used as a binder. The amendment is supported by the description at page 13, line 5 to page 11 and page 19, lines 10 to 13, inter alia, of the present specification.

In addition, in order to clarify the contents of claim 8 of the present application, the applicant separates 'depositing step' from step (1) of claim 8, and newly establishes its independent claim 23 directed to the deleted portion in addition to dependent claims 24-30 equivalent to claims 9, 12-16 & 20.

In addition, the applicant amends "sulfur or nanoparticles" of claim 12 to "the binder," and thus clarifies the subject material.

Meanwhile, it is our opinion that the invention set forth in amended claim 8, newly established claim 23 and their dependent claims of the present

application cannot be easily invented from the combination of the cited references by a person having ordinary skill in the art. Our comments in this regard are as follows:

(1) The invention set forth in claims 8 & 23 (hereinafter, 'present invention') relates to a process for preparing a carbon nanotube electrode, comprising the steps of: (1) preparing an electrode material by mixing carbon nanotubes with a binder selected from the group consisting of sulfur having an average particle size of 1μm or less, metal nanoparticles having an average particle size of 1μm or less and both of them, <u>wherein the binder has the effect of minimizing the internal resistance of the electrode</u>, (2) preparing a pressed electrode material by first pressing the electrode material under a pressure from 1 to 500 atm; and (3) subsequently pressing under a pressure from 1 to 500 atm, or heat-treating at a temperature in the range of the melting point of the sulfur or metal nanoparticles ±200°C in inert gas atmosphere, or simultaneously pressing under the said pressure and heat-treating at the said temperature in inert gas atmosphere the previously pressed electrode material that is placed on a current collector so that the carbon nanotubes are bonded to each other and simultaneously bonded to the current collector (Claim 8), and a process for preparing a carbon nanotube electrode, comprising the steps of: (1) preparing an electrode material by depositing a binder selected from the group consisting of sulfur having an average particle size of 1μm or less, metal nanoparticles having

an average particle size of 1μm or less and both of them on the carbon nanotubes, <u>wherein the binder has the effect of minimizing the internal resistance of the electrode</u>; and steps (2) and (3) are the same as those recited in claim 8 (claim 23).

In this regard, in order to overcome a technical problem that the internal resistance of the electrode is increased due to the organic binders when preparing carbon nanotubes to fabricate an electrode using conventional organic binders (the present specification at page 12, lines 6-19), the present invention provides electrodes made of carbon nanotubes characterized in that the binding within the electrode material comprising carbon nanotubes as well as between the electrode materials and the current collector is achieved by excluding the use of conventional organic polymers, using only sulfur or metal nanoparticles as a binder and by pressing and/or heating the electrode system (*see* page 12, line 25 to page 13, line 9 of the present specification).

That is, in manufacturing electrodes made of carbon nanotubes, the technical feature lies in minimizing the internal resistance of the electrode by using sulfur or metal nanoparticles as a binder, which has not been used in the prior art, and such technical feature is clearly shown in the claims by this amendment. In this regard, such technical feature is supported by a fact that the electrodes prepared according to the TEST 1 to TEST 7 described in the present specification at page 32, lines 1-6 have internal resistance lower than the values of internal resistance reported previously.

In contrast, the invention set forth in Dasgupta et al. relates to "an anode

for a lithium battery having a conductive substrate coated with a pressed compact of spherical graphite and an ion conducting polymeric binder, characterized by comprising the inclusion of up to 1.5 to 15% by weight of carbon nano-fibers in said pressed compact" (*see* Claim 1 of Dasgupta et al.). Like the prior art, Dasgupta et al. only discloses an ion-conducting polymeric binder as a binder used in manufacturing electrodes (*see* [0023] of Dasgupta et al), but does not disclose nor suggest the use of sulfur or metal nanoparticles as a binder and the effect of minimizing the internal resistance of the electrode by using thereof.

Meanwhile, the invention set forth in Gurin relates to "an enhanced conductivity nanocomposite, wherein the composite has reduced conductivity path directionality dependence, comprising of (a) a powder selected from the group consisting of metals, metal oxides, alloys, and combinations thereof, the powder having an average particle size of from about 1µm to about 100 µm, and (b) a carbon powder wherein the powder having an average particle size of from about 1µm to about 100 µm" (*see* Claim 1 of Gurin). The electrical conductivity nanocomposite described in Gurin is used for conductive inks, circuit boards, paints, etc. (*see* [0006] of Gurin). Meanwhile, Gurin discloses coating the metal particles on the surface of carbon nanotubes, but there is no teaching in Gurin of the technical idea of using sulfur or metal nanoparticles as a binder in order to solve a technical problem of increasing the internal resistance of the electrodes

when using organic polymers as a binder.

Accordingly, Dasgupta et al. and Gurin do not disclose nor suggest the technical feature of the present invention of minimizing the internal resistance of the electrode by using sulfur or metal nanoparticles as a binder, and thus the present invention cannot be easily derived from the combination of Dasgupta et al. and Gurin by a person having ordinary skill in the art.

(2) The present invention uses the sulfur or metal nanotubes as a binder, and prepares an electrode which minimizes the internal resistance of the electrode by first pressing the electrode material which is prepared by mixing or depositing carbon nanotubes with a binder, and subsequently pressing under a pressure from 1 to 500 atm, or heat-treating at a temperature in the range of the melting point of the sulfur or metal nanoparticles ±200°C in inert gas atmosphere, or simultaneously pressing under the said pressure and heat-treating at the said temperature in inert gas atmosphere the previously pressed electrode material that is placed on a current collector so that the carbon nanotubes are bonded to each other and simultaneously bonded to the current collector (*see* claims 8 and 23, step (3) of the present application).

In this regard, the specification of the present application at page 24, lines 2-8 describes that "Thus prepared electrode material is then pressed under a pressure of from 1 to 500 atm and/or heat-treated at a temperature where the nanoparticles of sulfur, metal or metal compounds can be made into a melted or

similar state, and thus the sulfur or metal nanoparticles deposited on the carbon nanotubes or carbon nanofibers achieve three-dimensional junction or fusion between these carbon nanomaterials and also smooth binding between the electrode material and a current collector." Hence, it can be confirmed that the binder attached to carbon nanotubes binds carbon nanotubes as well as between the carbon nanotube and the current collector by pressing and/or heating the electrode system at a temperature recited in step (3) of claims 8 & 23. Also, through the amendment to the present specification, it would be clear that the use of sulfur and metal nanoparticles during a process for preparing a series of electrodes comprising said step (3) of Claims 8 & 23 minimizes the internal resistance of the electrode.

Meanwhile, the examiner states at page 9 of the Office Action, "Dasgupta et al. disclose that the heat treatment may be carried out after preparation of the mixture of carbon particles, carbon nanofibers and binder (paragraph 0016), which is what is claimed in step 3 of the instant application. Dasgupta et al. disclose that the graphite/binder mixture is compressed into a pressed compact to form the shape of an electrode (paragraph 0023)."

In this regard, as disclosed at paragraph [0016] & [0028] and in claim 6, the heat treatment described in D1 at paragraph [0016] is carried out at 45-80°C, which does not damage organic materials, for the heat and vacuum treating of carbon nanofibers, after mixing the electrode materials and a binder and wetting

this mixture in an electrolyte to make this into a paste state.

Accordingly, different from the pressing and/or heat treatment of step (3) of claims 8 & 23 of the present application, the heat treatment of D1 carries out a heat treatment in a vacuum state, and thus it is different from the heat treatment in inert gas atmosphere of minimizing the internal resistance of the electrode by binding the CNTs as well as between the electrode material and the current collector of step (3) of the present invention.

In addition, step (3) of the present invention recites performing a heat treatment at a high temperature and simultaneously pressing under a high pressure in order to produce such an effect as above, whereas D1 does not disclose such technology.

The examiner states on pages 3-4 of the Office Action that since Gurin discloses metal deposited carbon nanotubes, the present invention can be easily derived from the combination of Dasgupta et al. and Gurin.

However, under the circumstances wherein Gurin merely suggests coating metal particles on the surface of carbon nanotubes, but does not suggest forming bonds between carbon nanotubes and sulfur or metal nanoparticles which is used as a binder of the electrode materials, and Dasgupta et al does not disclose a heat-treatment at a high temperature and a pressure in order to minimize the internal resistance of the electrode by binding the sulfur or metal nanoparticles which is used as a binder between CNT and CNT, and simultaneously binding the current collector with an electrode material, even a

person having ordinary skill in the art cannot easily derive claims 8 & 23 of the present application from the combination of Dasgupta et al. and Gurin.

As above described, applicant has amended the claim 8 (also included in new claim 23) to require that the "binder has the effect of minimizing the internal resistance of the electrode."

Therefore, each and every limitation of the claim has not been met and claims 8 and 23 should be found allowable including their dependent claims.

Arguments presented in the Response to the Office Action mailed October 5, 2007 are reasserted that no combination of the prior art meets the limitations of the claims as amended.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claims 8-9, 12, 14-16 and 20 under 35 U.S.C.§103(a).

2. The Examiner has rejected claim 13 under 35 U.S.C.§103(a) as being unpatentable over Dasgupta et al (US 2003/0152835 A1) and Gurin (US 2003/0151030A1), as applied to claims 8-9, 12, 14-16 and 20 above, and in further view of Choi et al, (US 2004/0018416A1).

Claim 13 is dependent on claim 12 and therefore should be found allowable for the reasons set forth above.

In addition, Choi et al. relates to depositing metal particles which are the CNT synthesis catalyst on a carbon substrate to synthesize CNTs by the chemical vapor deposition (CVD) reaction, and using the metallic catalyst particles

distributed on the internal and external surface of the CNTs (*see* paragraph. [0003], [0016] and [0020] of Choi et al.). That is, Choi et al. merely discloses metal particles as a catalyst used when generating carbon nanotubes, but does not disclose or suggest the use of metal particle as a binder for binding carbon nanotubes. Thus, even a person having ordinary skill in the art cannot easily derive using sulfur or metal nanoparticles as a binder instead of an organic binder for preparing an electrode material from Choi et al. Therefore, it is clear that the present invention cannot be easily achieved by a person having ordinary skill in the art from the combination of Dasgupta et al, Gurin and Choi et al.

Applicant, accordingly, respectfully requests withdrawal of the rejections of claim 13 under 35 U.S.C.§ 103(a) as being unpatentable over Dasgupta et al and Gurin, as applied to claims 8-9, 12, 14-16 and 20 above, and in further view of Choi et al.

In light of the above, Dasgupta et al., Gurin and Choi et al. neither suggest nor disclose the use of sulfur or metal nanoparticles for binding carbon nanotubes for manufacturing electrodes made of carbon nanotubes in order to minimize the internal resistance of the electrode. Further, the process disclosed in Dasgupta et al. is different from the step (3) of claims 8 and 23 of the present application.

Thus, it is clear that a person having ordinary skill in the art cannot easily derive the present invention from the combination of Dasgupta et al., Gurin and Choi et al. Also, claims 9, 12 to 16, 20 and 24-30 which depend from

claims 8 & 23 cannot be derived from the combination of Dasgupta et al., Gurin and Choi et al. Accordingly, the Applicant respectfully requests a Decision for Grant of Patent on the present application.

Applicant respectfully submits that the present application is in condition for allowance. If the Examiner believes a telephone conference would expedite or assist in the allowance of the present application, the Examiner is invited to call the undersigned at (408) 720-8300.

Please charge any shortages and credit any overages to Deposit Account No. 02-2666. Any necessary extension of time for response not already requested is hereby requested. Please charge any corresponding fee to Deposit Account No. 02-2666.

Respectfully submitted,

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